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interesting points will be deferred until I shall have been able to assemble more extensive and newer data.

N. ERNEST DORSEY.

ANNAPOLIS JUNCTION, MARYLAND,
January 31, 1903.

THE OVERSPUN STRING.

LOADING a string by 'overspinning' with wire, as is well known, causes it to produce a deeper tone without adding to its length. It, also, can be strung over a finger-board, where it may be 'stopped,' thus enabling a single string to produce an octave or more with its chromatic intervals, and to take the place of eight or more long open strings. So far as my information goes, the overspun string was introduced into France by St. Colombe about 1675. The chitarrone with its very long open bass strings dates from 1589 and was used in orchestras in 1607. I am desirous of ascertaining whether the superiority of the overspun string over the long open string for the deeper tones was known earlier than I have mentioned, and whether the chitarrone was used because the overspinning was unknown.

E. H. HAWLEY.

U. S. NATIONAL MUSEUM.

NOTES ON THE JUDITH RIVER GROUP.

IN August, 1876, Mr. J. C. Isaac (who had been my assistant earlier in the season in the chalk of Kansas) and myself joined Professor E. D. Cope at Omaha, to go with him as his assistants to the Judith River region in Montana. From Franklin, Idaho, we made the journey of 600 miles to Fort Benton by stage. Here the professor purchased a wagon, four work horses and three saddle ponies, employed a cook (to act also as teamster) and a scout, who was to warn us of danger from Indians. Sitting Bull with his thousands of braves was south of our field, fighting the soldiers. We traveled down the Missouri River opposite Claggett, an Indian trading post, 120 miles below Fort Benton. Here we crossed the river, and went into camp on Dog Creek, a few miles east of the Judith River, and about ten miles from its mouth. The cañon of this creek was narrow. We were shut in by the

dark and desolate Bad-lands, which, as I remember, the professor estimated as over 1,000 feet high. The lower slopes were composed of beds of lignite, from a few inches to six feet in thickness, and black shale, the lignite layers not appearing in the great bed of shale in its upper part. Professor Cope made a sketch of the wonderful panorama, which I afterwards saw published. The shale disintegrated into dust on the surface, into which one sank to his knees in climbing some steep ascent. This formation, Cope assured me, belonged to the Fort Pierre group of the Cretaceous. We found many bones in it, of mosasaurs and fishes, similar to those I had already collected in western Kansas. After my return from Montana I felt sure the black shales then called Niobrara belonged to the Fort Pierre, on account of their faunal and stratigraphical resemblances to those on Dog Creek. It was years, however, before this view was generally accepted. I remember one very good quadrate I picked up on Dog Creek which I thought belonged to a *Platycarpus*. We could have made large collections of these fishes and mosasaurs but for the fact they were poorly preserved and interfered with the main object of the expedition.

On top of the Pierre deposits, which were the thickest, were the buff-colored sandstones of the Fox Hills group. We found no fossils in it, but I was assured by Cope of their position in the series. The Judith River beds, or Cretaceous No. 6, as Cope identified them, were above the Fox Hills. The rocks of this formation were composed of sandstone and clay. On the very highest summits of the Bad-lands was a thin bed of oyster shells. We remained in our camp over a month here. Every morning at sunrise we were in the saddle, taking a lunch of crackers and bacon. We returned late in the evening. Our chief discoveries were from a yellowish sandstone, in which we found many bone-beds, where loose teeth, bones and fragments of turtle shells were mingled together, often weathered out, lying loose on the surface. I have been deeply interested in reading Professor H. F. Osborn's and Mr. L. M. Lambe's 'Contributions to Canadian Paleontology,' Vol. III.,

Part II., Ottawa, 1902. I was especially surprised to see by the table of the distribution of land and fresh-water Cretaceous vertebrates of the west, that many of the species we procured in these bone-beds on Dog Creek, some of which Professor Cope named on the spot, as I distinctly remember, are placed in the Montana column, which on page 9 is placed below the Pierre. I was the original discoverer of the fish *Myledaphus bipartitus* Cope. As I remember, he gave the specific name from the fact that the enamel on one side of the tooth was dark and light-colored on the other. With this species were hundreds of teeth of *Diclonius*, *Dysganus*, *Paleoscincus*, *Aublysodon*, numberless fragments of the beautifully sculptured shells of the turtles *Trionyx* and *Compsemys*, bones of *Camposaurus*, scales of *Lepidotus*, etc. In the list referred to I am astonished to find the genera *Diclonius* and *Dysganus* not represented in the Judith River column. If I mistake not I discovered the species of *Dysganus* he named in honor of the Peigan Indians on the spot. The four species certainly belong to the Judith River group. These remarks also apply to the three species of *Diclonius*. The new species of *Monoclonius* do not appear in the Judith River column. As they were discovered near Cow Island forty miles below Dog Creek, I will speak of them later. The facts I have here mentioned can readily be substantiated, if collectors will work over the summit of the Bad-lands, east of Dog Creek, as we found inexhaustible deposits of the genera mentioned above, excepting *Monoclonius*, of course all mingled together. As we were unable to discover any good specimens of complete skulls or bones in this region, Professor Cope took his guide and started on an exploring trip down the river. A few days later he sent word to us by his scout to move camp to Cow Island. The astonishing feat we accomplished, of getting our outfit on top of the Bad-lands, over slopes so steep that we had been obliged on horseback to make long angles in order to make the ascents. After fourteen hours of the most strenuous effort human nature is capable of we got to the level prairie. In one place our four-horse wagon with team

attached made three complete somersaults and landed on a ledge of sandstone right side up. The next day, while traveling along between the foothills of the Judith River Mountains, we saw in the distance a horseman approaching, whom we soon recognized as the professor. Before he reached us the scout came out from behind some hill to our south and intercepted him. An exciting conversation took place, judging from their gestures. The scout was the first to come to the wagon. Without a word he took his personal outfit and started toward Fort Benton. The cook followed him until out of our hearing, when they had an earnest talk. On his return to us he shouldered his blankets and grip, starting for a wood camp on the river, after a talk with Cope. We were never told the cause of these desertions, but learned afterwards that the scout had run across Sitting Bull's command in the Dry Fork of the Missouri, not many miles from where we proposed to make our next camp, and being unable to induce the professor to give up his expedition, left us alone in an unknown country. With double labor to perform, we pressed on and made our camp on the river a few miles below Cow Island, on the opposite side at some old steamboat snubbing-posts. We made no other while Cope was with us. He took passage down the river about October 15. I find by consulting the following letter that Professor Cope had become confused in regard to the localities of the four specimens we found near Cow Island of the genus *Monoclonius*:

PHILADELPHIA, Dec. 21st, 1889.

Dear Mr. Sternberg:

I am going over the fossils you and Mr. Isaac collected on the N. side of the Missouri River in 1876. I send you a paper showing how far I have got along with the study. I want to ask you some questions. 1st, Did you get the *Monoclonius* you marked, at exactly the same spot as where I dug up (with your help) the bones of the animal I so named? If not, how far off did you get them? I refer especially to the animals figured on Pl. XXIII., figs. 2 and 2a.

2nd. Isaac got a lot of bones somewhere in the same neighborhood, I think further west. How far off was that? There are four separate animals, all supposed to come from the place where

I got *Monoclonius crassus*; two of these I got. Both are *M. crassus*. Two you got, one larger (*M. spenocerus*) and one smaller (*M. fissus*) than mine. It is about these latter that I want information. Marsh has been duplicating this work in his usual shameless style. According to him, nothing has been done in this field before. He made a good beginning by describing the horns of one of these fellows as a new species of bison. Answer soon.

Very truly,

E. D. COPE.

I remember distinctly helping the professor collect his type specimen. It was on the south side of the river, between our camp and Cow Island. The specimens I collected and those of Mr. Isaac were near together, on the north side of the river, about five miles below Cow Island Station. To my knowledge, Cope never collected on this side. He took passage on a steamboat the day after we crossed, about October 15. Mr. Isaac and myself made a camp about three miles below the station afterwards, and the material referred to was found some distance below our camp. These thick deposits Cope called Cretaceous No. 6, or Judith River group. So I was surprised to find none of the species of *Monoclonius* in the Judith River column. The fish *Hedronchus*, named in my honor, came, I am sure, from the bone-beds in the Dog Creek region. To help solve the problem of the age of these beds it seems to me one way would be to put the Dog Creek fossils in their proper place in the column, and not confuse them with the *Monoclonius* material that was only found by us near Cow Island. If the type localities are systematically studied and the stratigraphical characters fully understood, proof may be forthcoming that the *Monoclonius* beds are older than the Judith River. They are certainly forty miles further down the Missouri than the unmistakable Judith River beds that rest on the Fort Pierre and Fox Hills at Dog Creek.

CHARLES H. STERNBERG.

SEEDS BURIED IN THE SOIL.

NUMEROUS cases are on record in which seeds are said to have remained dormant in the soil for some considerable time, varying from a few years to many centuries. Such reports have always been and will continue to be of

much popular interest because many of these seeds, when taken, by chance, from their accidental burying ground and exposed to conditions favorable for germination, have, in many instances, indicated a remarkable prolongation of vitality. It must, however, be remembered that such reports are based chiefly on accidental results, in most cases being even highly speculative, and are, therefore, of but little value in furnishing reliable data as to the length of time seeds will retain their vitality when buried in the soil.

The time required for the completion of such experiments must necessarily extend over a number of years, and for this reason but very few actual experiments have been made. The most important are those of Dr. Beal, as reported in the *Michigan Farmer*, November 30, 1901, in which he found that seeds of twelve out of twenty-one species responded to germination tests after having been buried for twenty years.

In so much as the question is continually being asked, 'How long can seeds remain buried in the soil and still retain their power of germination?' we have started a series of experiments in connection with our work in the Seed Laboratory of the U. S. Department of Agriculture, with the hope of securing some definite data and thereby answering this question once for all. For these experiments we have taken 112 different samples of seed, representing 109 species, 84 genera and 34 families. These have been so selected as to include seeds of most of our common field and garden plants, as well as seeds of many of the grasses and our most noxious weeds. These seeds were first carefully counted, of most samples 200 seeds being taken; however, only 100 of some of the larger seeds such as beans, peas, corn, etc. The seeds were all of the harvest of 1902, save two of the duplicate samples of red clover.

Preparatory to burial the previously counted samples of seed were mixed with dry clay soil and packed in well-baked, porous clay pots of four, three and two inches diameter, depending on the size of the seeds; inverted clay saucers serving as covers for the various pots.